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TIMBER STAND IMPROVEMENT IN THE PONDEROSA PINE TIMBER

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General

Fire, insects, and other natural agencies have caused numerous openings in the ponderosa pine stands of southern Idaho. Many of these openings have been regenerated with dense, more or less evenaged groups of reproduction, which are in such severe competition for light, soil nutrients and moisture that maximum increment is not being produced. Many diseased, defective, porcupine-injured, and otherwise undesirable trees occupy space, offering competition to the well-formed desirable trees. A number of snags resulting from fire and insect damage remain as a part of the overstory and constitute a continual fire hazard. Improvement measures are necessary if these stands are to be placed in their most productive state.

The cost of stand improvement work in the past has been prohibitive on any large scale. But with the change in our economic order and improvement in our forest protective system, it is now considered feasible to make at least one improvement cutting during the life of the stand. For silvical reasons it is preferable to make this cutting at a time when the stand is young, thus avoiding stagnation and the consequent loss in growth. The products of an improvement cutting in these young stands are unmerchantable for the most part and therefore, no immediate financial return can be expected to defray the cost of the operation. As a consequence the cost of stand improvement work

must be considered as a fixed investment and in order to keep this investment as low as possible, it is imperative that methods be devised to improve the conditions in the stand at a minimum cost. This may be most efficiently accomplished ordinarily by felling the snags in the overstory and treating the young stands by removing the defective trees and sufficient other trees, to liberate the comparatively few individuals desired in the final crop.

The greater share of the cost of stand improvement work arises from the treatment or thinning of young stands. Oftentimes the cost of thinning in these stands is unusually high because all trees except the "crop trees", spaced at specified intervals, are removed. In fact, this has been the conventional method of thinning in the past. It is possible, however, to modify this conventional method of thinning and secure equally as good results at less cost. The modification of this method requires that only those trees which interfere with growth requirements of the "crop trees" be removed, allowing all noncompeting trees to live or die of their own accord. By this modified method only the most desirable trees in the stand should be released, affording them the opportunity to attain a dominance which can be maintained until maturity. The cost involved in the felling of snags is constant under all methods.

Field Investigation in Stand Improvement

This report covers an initial investigation of the timber stand improvement problem on the experimental forest near Idaho City, Idaho. Four different methods of treatment were selected for application to a

portion of the area which has an established stand of virgin ponderosa pine with a heavy understory of advance reproduction. The four methods of treating the understory were based largely on spacing of the residual stand after thinning and are described briefly as follows: (1) A conventional method in which trees were selected to leave at regular intervals of 10 feet. All other trees in the stand were removed. (2) A "crop tree" method with a 10 foot spacing in which the most desirable trees were selected at intervals of 10 feet, and only those trees were removed that were in active competition with the selected trees. (3) A "crop tree" method with a 15-foot spacing, and as in (2) only enough trees were removed to liberate the selected crop tree. (4) Another "crop tree" method based on the same principle as in (2) and (3), except the spacing interval was 20 feet.

In thinning by the "crop tree" method, as in the last three methods described above, an adequate number of trees were removed from around the crop trees so as to allow a space of about 3 feet or the length of an axhandle between the crown of the selected tree and its nearest neighbor. Thus all trees whose crowns projected within the circle of 3 feet around the crown of a crop tree were cut. In clearing a space of 3 feet between tree crowns, the distance on the ground between the stem of the crop tree and the stems of the neighboring trees varied directly with the size of the trees. Thus not only was crown competition eliminated, but root competition was reduced greatly. No trees outside of the above described zone around each crop tree were cut.

In making the improvement cuttings in these young stands, the spacing of the crop trees was the primary basis of selection, although crown class of the trees was considered, and, insofar as possible, all trees selected were dominant even to the extent of somewhat modifying the desired spacing. In some instances it was desirable to discriminate against a dominant tree in favor of a codominant tree since by removing the dominant, two codominants would be released, whereas, if the dominant were left, it would be necessary to remove both codominants. Codominant trees were also selected in some instances as crop trees in order that the desired spacing might be secured. No injured or defective tree was selected as a crop tree if it were possible to leave a sound, thrifty one. In some places where porcupine injury was exceedingly heavy and it was not possible to find an uninjured tree, a damaged tree was selected as a crop tree so as to avoid opening the stand too much, thus drastically exposing the site. Douglas fir, except in a very few places where a well-formed individual occurred at the desired spacing, was cut in favor of the pine. In general, an effort was made to obtain the best possible spacing with the most desirable trees with quality of the crop tree rather than spacing as the main criteria of selection.

On the experimental area, the treatment applied to any one plot was chosen randomly without regard to the size of the trees on the plot. For instance, a 20-foot spacing was applied to a plot where the height of the average tree was very small. As a consequence, the thinning of that particular plot was hardly noticeable and the number of designated

crop trees too few for trees of that size. While this method of procedure is entirely satisfactory from the experimental or demonstration standpoint, it is not suited to thinning on a large scale where spacing should vary with the size of the trees in the stand. In determining the proper spacing to be applied to any stand, the following rule of thumb has been devised as a guide from the experimental cutting: In stands where the dominant and codominant trees average less than 25 feet in height, spacing should be equal to the average height of the dominant and codominant trees smoothed to the nearest 5 feet. For example, if by taking a few representative samples in a stand it is found that the average height of the dominant and codominant trees is 17 feet, the spacing recommended for this particular stand or part of the stand would be 15 feet. If the dominant and codominant trees in a stand to be thinned average more than 25 feet in height, the distance used in spacing the crop trees should not exceed approximately 25 feet. Of course, this rule of thumb applies to sapling stands only and if improvement cuttings are made in larger and older stands, the distance used in spacing should depend upon the number of trees desired in the final crop and the amount of thinning that is required to secure proper release of the crop trees. Thinning should not be considered in stands averaging less than 5 feet in height and rarely in stands less than 10 feet in height. The cost of thinning these stands of small trees as compared to the benefits derived seems to warrant leaving them until a time when thinnings will be more advantageous.

Costs

It is rather difficult to obtain cost figures from the experimental plots which are applicable to large areas. Detailed costs, however, were recorded for the different methods of thinning and in general thinning to a spacing of 20 feet on a crop tree basis can be done for approximately one half the cost of thinning to a 10-foot spacing on the same basis. The costs obviously vary greatly with the number of trees to be cut and the average diameter. A correlation of costs with diameters and number of trees cut show that 65 percent of the variation in costs from plot to plot are directly associated with variation in diameter and number of trees cut. It required an average of approximately $2\frac{1}{2}$ man-days, exclusive of slash disposal, to improve an acre on the basis of a 20-foot spacing as compared to slightly less than 4 man-days to improve an equal area on a basis of a 10-foot spacing, both methods following the "crop tree" scheme.

Advantages of Crop Tree Method

It is recommended in general that the crop tree method of thinning be used on the forest as a whole since thinnings can be more efficiently accomplished with just as desirable results as by other methods. Assuming that the amount of release given to each crop tree is sufficient to establish its dominance in the residual stand, the advantages of the "crop tree" system in comparison with the conventional method are: (1) Greater selection can be exercised and more attention given to each crop tree under the crop tree system since it is not necessary to space the trees as regularly or as close together as required

under the conventional method; (2) the presence of trees other than the ones selected for crop trees serve to fill in the stand in the event a crop tree is injured or destroyed, whereas in conventional methods of thinning, the death of a crop tree means an opening in the stand; (3) the site is given protection by the presence of the uncut trees between the crop trees; (4) the cost is less because the number of trees cut by the crop tree method of thinning is considerably less than by conventional methods; (5) for the same reason as stated in (4) there is less slash involved in the crop tree system of cutting.

Thinnings that border on highways as well as around public campgrounds and other recreational areas where the esthetic values at the present time are greater than the silvicultural requirements of the future, should be made in the conventional manner by removing diseased, defective, and suppressed trees. Opening a stand too drastically should be avoided. Natural conditions should be preserved as far as possible where the recreational and esthetic values of the forest are a paramount consideration. In these cases it may be desirable to even leave oddly formed and misshapen trees for the sake of the interest that they may arouse. Conventional thinning may also need to be used on areas which support a stand that has been severely damaged by porcupines or mistletoe.

Size and Organization of Crew

The size of the crew that can be handled efficiently by one technical foreman will depend upon the topography of the area to be treated and the continuity of the stand. Adequate supervision is most difficult on areas of steep topography or where the continuity of the stand is

broken up by openings and the crew is distributed over a large area. In CCC work a crew of 15 to 25 men will be most effective, both from the standpoint of efficiency, and the quality and quantity of the work performed. A crew of this size should be divided into two or three smaller groups or subcrews of 6 to 8 men, under the direct leadership of a subforeman. The duty of the subforeman is to assist in the supervision and to direct the work of the men. He should be used as one of the choppers and regulate the pace at which the crew will work. A 2-man saw crew should be used to fell the snags and they should keep well ahead of the thinning crews. All snags and other undesirable large trees should be removed prior to the thinning operation so that any injury occurring to the stand may be considered at the time of thinning.

Frequently it is desirable that a follow-up crew be formed by selecting a different man from each subcrew daily and having them check the cutting of the previous day. Such an arrangement enables the foreman to give special instructions to individuals of his crew on the days when they join the follow-up crew, as well as enabling the chopper to see more clearly errors made in the work.

In training a crew for thinning work, instructions should be given in small groups. The members of each group should do all phases of the work, from selecting crop trees to actual cutting. It is not necessary to mark crop trees ahead of cutting since this is an additional item of cost and crews working in marked stands perform mechanically and display little interest in their work. To secure the best results, however, one or two crop trees should be selected by the chopper in ad-

vance of cutting, in other words, the chopper should know in advance what and where his next crop trees are, each tree being his own selection. This procedure insures the best organization of the crew and the most desirable spacing in the residual stand. Each crew, or at least each subcrew, should be organized so that the men work in parallel strips.

Slash Disposal

Complete slash disposal following a thinning operation is costly, probably doubling the cost in many instances. For this reason it is desirable to make as little slash disposal as possible, and still avoid greatly increasing the fire hazard by allowing large quantities of slash to accumulate. It is recommended, therefore, that for the present slash disposal be considered as varying with the size and density of the stand and that practices governing disposal should be adopted to meet various local conditions. If slash is to be disposed of, two general methods should be considered for every thinning operation: one of complete disposal by moving the slash into openings and piling and burning, or one of disposing of the slash in strips in order to break the area up into small blocks of from 5 to 10 acres or less, attempting to utilize natural openings and breaks as protective strips at all times. If the strip method is employed, disposal can be greatly facilitated by judicious felling of trees. It would be wise, therefore, to make a few trial cuttings under different conditions, so that the method of slash disposal can be selected prior to the general thinning operations.

Where disposal of the slash is not necessary, all trees cut should be felled so that they lie parallel to one another and preferably parallel

to the slope of the ground. This tends to prevent concentration of the slash that otherwise would result if the trees were left in a haphazard, criblike condition on the ground and facilitates fire control and the movement of men over the area. Trees felled across a down log should be cut at the log so that the tops will fall to the ground. Felled trees that are more than 10 feet long may be cut into sections of 8 or 10 feet so as to facilitate handling them in case it is necessary to move the material in the construction of a fire line and also to allow the sections to lie closer to the ground. On larger trees it may be desirable to lop heavy limbs.